

THE OVARY AND FRUIT OF CARPACOCE.

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Some time ago Paymaster-Captain T. M. Salter drew my attention to certain peculiar features of *Carpacoce vaginellata*, a new species belonging to the tribe Anthospermeae of the family Rubiaceae. In the Flora Capensis Sonder, when constituting the genus *Carpacoce*, stated that there was only one style but that the ovary was two-chambered and had two ovules. He then went on to say that the fruit was two-seeded and separated into two portions when ripe, but that it might be one-seeded by abortion. Bentham and Hooker in the Genera Plantarum agreed with Sonder with regard to the ovary but described the fruit as having a coriaceous exocarp which separated from a crustaceous, wrinkled inner portion. This latter was stated to be one-chambered and one-seeded. These authors concluded by saying that they had never seen a two-chambered fruit such as that described by Sonder. Phillips in the Genera of South African Flowering Plants adopts Sonder's description of the ovary and fruit.

An examination of the fruits of *C. vaginellata* showed that Bentham and Hooker's account was substantially correct for the fruit of that species at any rate. Unfortunately, as is pointed out by Captain Salter in a paper published concurrently with this,* *C. vaginellata* is erratic in its flowering habits, and flowers in all stages of development were not available for study. However, it was found that the much more common species, *C. spermacoea* agreed with *C. vaginellata* in all essential features of its ovary and fruit. The following account, which is based on a study of flowers and young fruits of *C. spermacoea*, may therefore be taken to apply to both species in all but unimportant details.

DEVELOPMENT OF OVARY AND FRUIT OF *C. SPERMACOCEA*.

Careful dissections of the ovary in young flowers have failed to reveal the two-chambered structure supposed to be characteristic of this genus. During the ripening of the fruit the ovary wall becomes differentiated into an outer leathery layer (the exocarp) and an inner crustaceous layer (the endocarp). The whole inner portion bounded by the endocarp is easily detached and may be mistaken for the seed which lies within. A

*Notes on some species in the family Rubiaceae in the Cape Peninsula.—Journal S.A. Botany III p. 109, 1937.

view of this structure after the removal of the exocarp is given in Fig 1, and it will be noted that the much wrinkled endocarp is grooved down one face and hollowed out at the base. A swollen, somewhat spongy tubercle (Fig. 1 *x*) fills this hollow and in the view depicted is partially

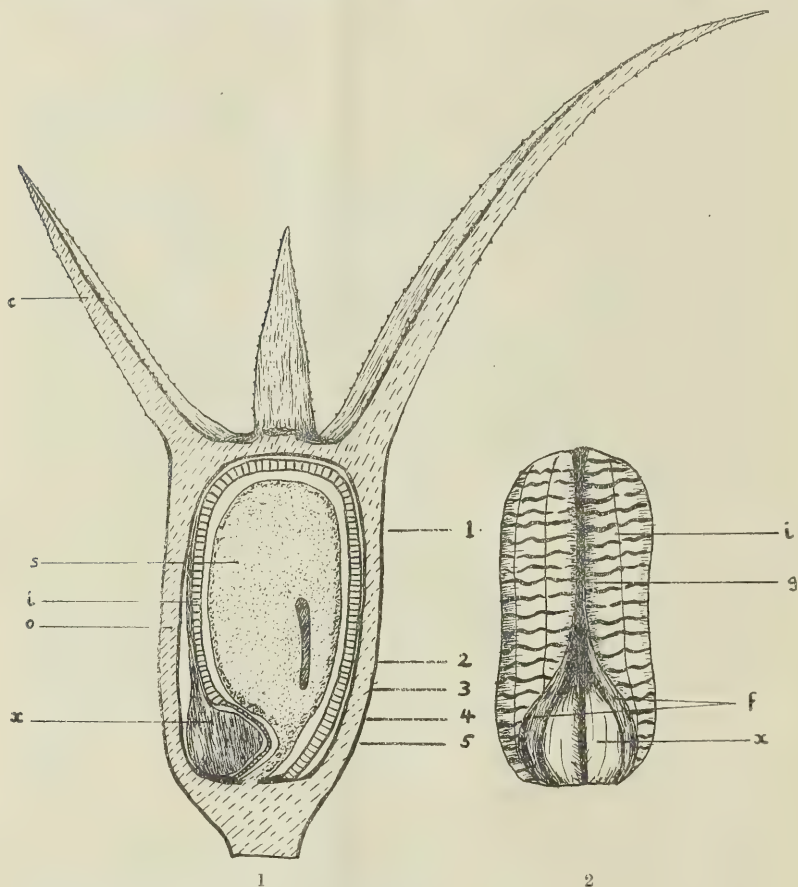


FIG. 1. *Carpacoce spermacoea*. View of the fruit, with the outer layer of the ovary wall removed, facing the parenchymatous swelling $\times 15$. *i*, wrinkled inner layer of the ovary wall; *f*, flap-like extension of inner layer; *x*, parenchymatous swelling; *g*, groove.

FIG. 2. *Carpacoce spermacoea*. Diagrammatic representation of a median longitudinal section through the young fruit $\times 15$. *s*, young seed with embryo; *i*, inner layer of ovary wall; *o*, outer layer of ovary wall; *x*, parenchymatous swelling; *c*, lobe of calyx. The positions marked 1—5 indicate the approximate levels at which the sections illustrated in Figs. 3—10 were obtained.

enveloped by non-wrinkled extensions of the endocarp (Fig. 1 f). In the ripe fruit the tubercle is easily detached. Fig. 2 is a diagram of a median, longitudinal section through the fruit showing the relative positions of the parts. It will be seen that the young seed, which occupies the centre of the fruit, has its funicle bent and pushed to one side by the tubercle.

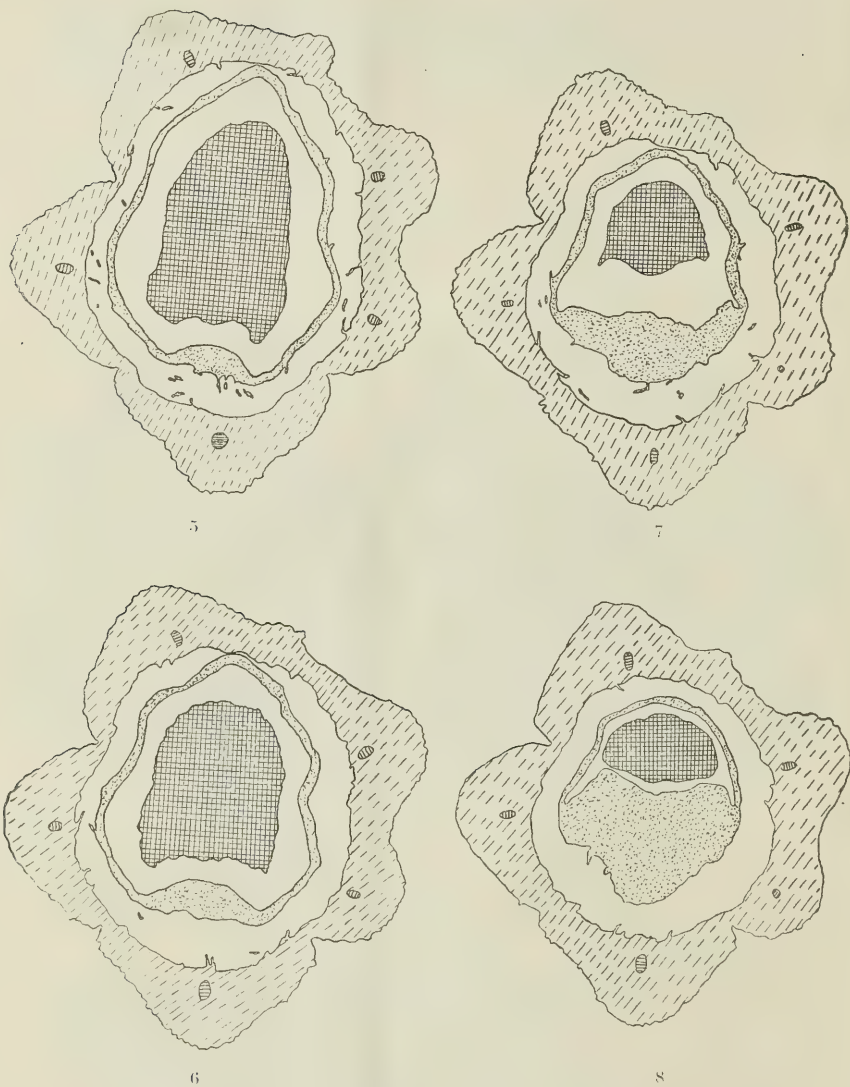
In view of the facts that a two-chambered ovary is the rule in Rubiaceae, and that this genus clearly possesses a single chamber, it was thought desirable to trace the development of the ovary in order to



FIGS. 3, 4. *Carpacoe spermacocoe* $\times 122$. For explanation see text.

ascertain the true nature of the parts which become differentiated in the fruit. In order to do this serial sections, $12\ \mu$ thick, were cut transversely through ovaries in various stages of development.

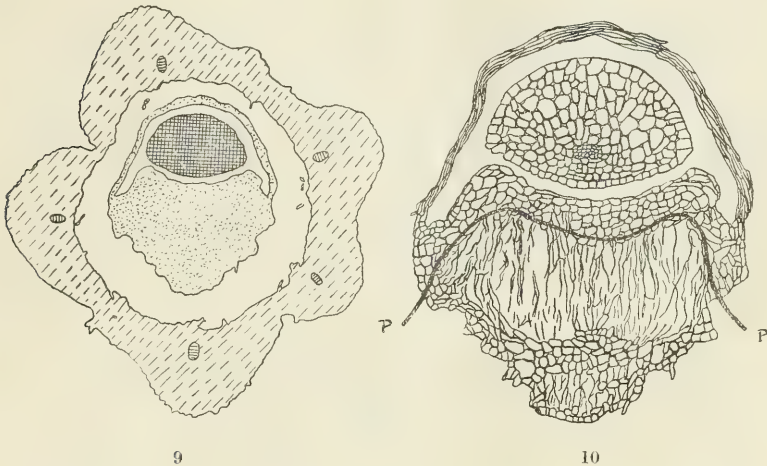
Figs. 3 and 4 depict transverse sections through a young ovary in which the ovule showed an early stage in embryo-sac development. The figures were drawn from sections cut at levels 1 and 5 respectively (see Fig. 2). In both figures the breaking down of the middle layer of the ovary wall is clearly seen, and as the inner layer ultimately becomes the wrinkled endocarp, its morphological nature is established without doubt. In Fig. 3 the inner layer shows a slight increase in thickness in



FIGS. 5, 6, 7, 8. *Carpacoce spermacocca* $\times 60$. For explanation see text.

the lower part of the section. In Fig. 4 this wider portion is emphasised but it will be noted that the cells are all more or less alike.

The diagrams (Figs. 5—9) were made from sections of a much older ovary. Here the young seed showed a pro-embryo embedded in copious endosperm. These diagrams, taken in order, were made from sections cut at levels 1 to 5 as indicated in Fig. 2. The inner and outer layers of the ovary wall are quite separate though the remains of the broken down tissue of the middle layer are still evident. In Fig. 5 a slightly thickened portion of the inner layer is shown. This is more pronounced in Fig. 6 which was drawn at level 2, just where the tubercle is approached. In



FIGS. 9, 10. *Carpacoe spermacoea*. FIG. 9, $\times 60$. FIG. 10, $\times 122$. For explanation see text.

the remaining figures, taken at successively lower levels, the development of a much swollen region of the inner layer is depicted. This is the young tubercle which is a late development of part of the inner layer of the ovary wall. Fig. 10 is an enlarged and detailed drawing of the inner tissues shown diagrammatically in Fig. 9. It will be seen that the swelling of the tubercle is due to the enlargement of cells which are present in the earlier stage (Fig. 4).

In the ripe fruit a split in the tissues occurs as indicated by the line P—P (Fig. 10), so that finally the ripe seed is encased in tissues derived from part of the endocarp while the remainder of the endocarp goes to form the tubercle.

Before passing on to a discussion of these results, it should be noted that just where the style passes into the ovary a small cavity is often present, extending for a depth of about 0.1 mm. This cavity occupies a somewhat eccentric position and lies to one side of the vascular strand. Where the cavity itself is not present a small patch of deeply staining tissue occupies the same position. In this plant the main portion of the style shows no central hollow, but it is possible that the small cavity to which reference has been made, may be regarded as a reduced stylar cavity.

DISCUSSION.

The foregoing account makes it quite clear that in this plant there is no obvious second carpel present. The unilateral swelling of the inner layer of the ovary wall (Fig. 4) may give a hint as to the position of a carpel which has all but disappeared in the course of evolution. It is, however, certain that the conspicuous tubercle of the fruit is a post-fertilisation development. Though it may have arisen as a secondary structure from the rudiment of the second carpel, it would be incorrect to speak of it as a reduced carpel.

Carpacoe vaginellata agrees so closely with *C. spermacoea* in all essential features of its ovary and fruit that there can be little doubt that its development proceeds in much the same manner as that described above.

As Captain Salter points out in his paper, there has been much confusion between *C. scabra* Thunb. and *C. vaginellata* Salter, which are very similar in vegetative features. It is possible that this similarity may have led Bentham and Hooker astray. Their statement that the ovary is two-chambered and has two ovules may have been based on an examination of *C. scabra*, and their description of the fruit may have been obtained from *C. vaginellata*. Unfortunately very little is known of *C. scabra* but it is certain that the ovary is correctly described as being two-chambered with one ovule in each. The subsequent development into a fruit which is said to separate into two portions suggests strongly that it is not closely related to *C. vaginellata* and *C. spermacoea* but would be more correctly placed in *Anthospermum*. With the removal of *C. scabra* the genus *Carpacoe* would be amenable to much more precise definition than is possible at present; a definition based on good characters of ovary and fruit. However, fresh material of *C. scabra* is essential before its correct systematic position is established. Until such material is available, it must suffice to state that its position in *Carpacoe* is open to considerable doubt.